REMARKS

In accordance with Applicants' position (as will be discussed below), claims 1-7, 11, and 13-21 remain in the application. No claims have been amended or cancelled by this amendment.

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attached pages are captioned "**Version with marking to show changes made.**"

I. SUMMARY OF THE DECEMBER 24TH, 2002 OFFICE ACTION.

A. Restriction

The previous office Action mailed July 31, 2002 repeated a telephone restriction between:

-Specie I: process for forming an integrated circuit (figs. 1-6)

-Specie II: a process for forming a dual damascene structure (figs. 7-11).

Applicants, in both the telephone interview and in their response dated October 31, 2002, originally elected specie I, with traverse. Applicants', in their prior amendment, stated their position that other than the name of the final product made by the claimed process, there was not a patentable distinction between the claims of the two groups. This remains as Applicants' position. Stated in another way, all of the claims (and all of the Figures) relate to the formation of a densified layer over a low k dielectric material, with claims such as claim 1 reciting the capability of forming an etch mask from the densified layer, while the remainder of the claims go on to recite the actual step of forming an etch mask from the densified layer, and some of the claims recite the further use of the etch mask of densified material to etch openings in the low k dielectric material. All of such steps are used to form a "dual damascene" structure.

Now, in the Final Rejection, the USPTO, in responding to Applicants' traversal of the restriction, takes the position (as understood) that Applicants have admitted that claims 2-7, 11, and 13-21 (all of the claims remaining in the case save claim 1) are drawn to a dual damascene structure and therefore are drawn to a non-elected species. Furthermore, the USPTO makes the following statements:

> "Applicant's election with traverse of species I in Paper No. 8 is acknowledged. The traversal is on the ground(s) that there is no patentable distinction between the claims of the two groups. This is not found persuasive because the embodiment found in figs. 7-11 containing via openings and trenches ***that require etching steps*** while the elected embodiment of figs. 1-6 ***do not require etching***." (emphasis added)

The above statement in the Rejection that the embodiment of Figures 7-12 contains via openings and trenches which require etching steps while the embodiment of Figures 1-6 do not require etching is simply not true. Attention is directed to openings 24 etched in densified layer 20 in Figure 2; to openings 14/24 etched in layers 10 and 20 in Figure 3; and to openings 44 etched through layer 44 in Figure 5. The reading of page 11, line 1 to page 12, line 26 of Applicants' specification (which describes such etching) is also recommended.

The USPTO initially restricted Applicants' claims based on the allegedly respective processes for forming an integrated circuit structure of figs. 1-6 versus forming a double damascene structure of figs 7-12. Now it appears that the restriction has been changed or modified to hinge on whether or not the respective figures illustrate etched openings or not. It should be noted that the restriction was not between allegedly different inventions claimed in specified claims, but rather through alleged differences between the figures - differences which, it now appears, apparently exist only in the imagination.

It remains the position of Applicants that neither the original restriction nor the modified restriction is well founded, and the restriction(s) should be withdrawn.

B. **Section 103 Rejection**

Claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang et al. U.S. Patent 6,028,015.

II. THE REFERENCE

A. The Wang et al. Reference

Wang et al. U.S. Patent 6,028,015 describes a process for protecting a low dielectric constant organo silicon oxide insulation layer against absorption of moisture by treating exposed surfaces of the low k material (damaged surfaces) with a hydrogen plasma. When forming openings such as vias or trenches in such low k material, a photoresist mask is conventionally employed and then subsequently removed after formation of the openings. However, when the dielectric material in which the opening is formed comprises a low k material, having organic material bonded to the silicon, subsequent removal of the resist mask by conventional oxidation or ashing processes results in damage to the bonds between the organic materials and the silicon atoms (severance of such bonds), resulting in oxidation of the organic material, and leaving silicon atoms with dangling bonds. Such dangling bonds of the damaged silicon atoms are capable of bonding with hydroxyl atoms, resulting in the absorption of undesired moisture on and in the low k insulation material. Wang et al.'s treatment of their low k insulation material with a hydrogen plasma is to repair an already damaged low k material by providing a source of energized hydrogen atoms which can bond with the damaged silicon atoms having the dangling bonds to thereby remove potential bonding sites for moisture absorption.

III. THE INVENTION

Applicants' claimed invention comprises a process for forming a layered integrated circuit structure having at least one layer of low k dielectric material, and an overlying layer of densified dielectric material. The process for making the structure comprises: first forming a layer of low k dielectric material over a substrate such as a previously formed integrated circuit structure; and then (before exposing the layer of low k dielectric material to any etchant treatment) treating the upper surface of the layer of low k dielectric material with a plasma to form (from the surface portion of the layer of low k insulation material) a layer of densified dielectric material which extends over the remainder of the underlying layer of low k dielectric material.

Optionally, a second layer of low k dielectric material may be formed over the just-formed layer of densified dielectric material, after which this second layer of low k dielectric material is treated in the same manner to form a second layer of densified dielectric material over the second layer of low k dielectric material. The layer or layers of densified dielectric material formed from the low k dielectric material provide mechanical support to the remainder of the structure, and can further function as etch stop and/or mask layers for the formation of vias and/or trenches. The formation of a stack of layers comprising two such densified layers, each over a layer of low k dielectric material, may also be used to form a dual damascene structure.

IV. DISCUSSION

Claim 1 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang et al. U.S. Patent 6,028,015. The Office Action, in comparing the teachings of Wang et al. to the claimed invention, admits that Wang et al. does not teach forming a first low k material and treating the upper surface of the first low k material prior to any exposure of the first low k material to etchant. The Rejection states that selection of the order of process steps is prima facie obvious in the absence of new or unexpected results, and then dismisses this absence of

such teaching in the Wang et al. reference by stating that it would be obvious to one skilled in the art at the time the invention was made to modify the process of Wang et al. by densifying the first low k material prior to etching because densification reduces moisture.

Applicants disagree. Densification is taught by Applicants, not by Wang et al. One cannot change the order of **unknown** process steps. Furthermore, the courts have required some suggestion in a reference of the desirability of a modification. One cannot suggest the desirability of making unknown modifications, or of changing the order of unknown modifications. It is not, from the teachings of Wang et al., obvious to treat the surface of low k material with a densification step ***prior*** to an etching step.

The Rejection, in response to Applicants' arguments that Wang et al. is already damaged, says that this is not important because it is not in Applicants' claim 1. Applicants must again disagree. In the first place, the USPTO apparently is requiring that the Applicants recite, in their claims, the absence of damage which occurs in Wang et al., but not in Applicants' process.

Furthermore, Applicants, in the language added to claim 1 in the previous amendment, recognizes that etching is what causes the damage that Wang et al. subsequently seek to fix, and recite the following words in the first line of step b in their claim 1:

> "...then, ***prior to*** any ***exposure*** of said first layer of low k dielectric material ***to etchants***, treating the upper surface of said first layer of low k dielectric material..." (emphasis added)

Thus, Applicants have recited in their claims that their treatment is (unlike Wang et al.) ***before*** the damage, and contra to that which the USPTO alleges. Furthermore, Applicants have also pinpointed the time of their treatment by the use of the word "then" at the beginning of their step b). Applicants' densification step occurs ***after*** formation of the layer of low k dielectric material but ***before*** exposure to etchants.

With regard to the use of the word "comprising" in their claims, Applicants must point out that the generalized meaning of "comprising" cannot change the specific recitations in Applicants' claims. Applicants' claim 1, step b) recites that their treatment of their first low k dielectric layer occurs "...prior to any exposure of said first layer of low k dielectric material to etchants...". The addition of 10,000 additional steps (permitted by "comprising") cannot change that recitation (prior to exposure to etchants) in Applicants' claims, a recitation, that Wang et al. cannot make!!

Thus, the fact that Wang et al. treats his materials ***after*** their damage occurs is important and has been distinguished from Applicants' invention by Applicants in their claims.

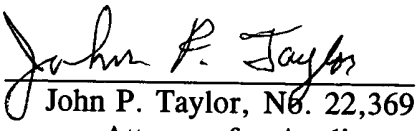
It should also be noted that both masking and etching steps occur later in Applicants' process, but that the USPTO has ruled, by virtue of the restriction in this case, that such masking and etching steps belong to a different and patently distinct invention.

Applicants' claimed invention, as claimed in claims 1-7, 11, and 13-21 are not obvious in view of Wang et al., nor should they be restricted from one another.

V. SUMMARY

It is Applicants' position that the teachings of Wang et al., when taken as a whole, does not suggest Applicants' claims. If the Examiner in charge of this case feels that there are any remaining unresolved issues in this case, the Examiner is urged to call the undersigned attorney at the below listed telephone number which is in the Pacific Coast Time Zone.

Respectfully Submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

The paragraph beginning at page 8, line 17 (as amended in the previous amendment mailed October 31, 2002), has now been further amended as follows:

The layers of low k dielectric material described herein may comprise carbon-doped silicon oxide dielectric material or any other type of low k dielectric material capable of being treated in a plasma to form, from the surface portion of the low k dielectric layer, a densified layer of dielectric material having characteristics resembling a conventional (non-low k) silicon oxide or silicon carbide dielectric material. Low k dielectric material suitable for use in this invention and capable of being treated to form the desired layer or layers of densified dielectric material can be formed using processes and equipment commercially available from, for example, Novellus, AMAT, Trikon, ASM, Dow Corning, Hitachi, Dow Chemical, Honeywell, Schumacher, and W.L. Gore. Other low k dielectric materials which may be used in the process of the invention include the low k dielectric materials described in U.S. Patent Nos. 6,303,047, issued October 16, 2001, and 6,365,528, issued April 2, 2002, and U.S. Patent Application Serial Nos. ~~09/590,310;~~ 09/792,683; 09/792,685; and 09/792,691; all of which patents and applications are assigned to the assignee of the invention; and the subject matter of each of which is hereby incorporated by reference. The formation of densified dielectric material on the surface of a low k dielectric material is also disclosed in Sukharev et al. U.S. Patent No. 6,114,259, issued September 5, 2000 and assigned to the assignee of this application, and the subject matter of which is hereby incorporated herein by reference.